REMARKS

Claims 1-15 and 17-33 currently appear in this application. The Office Action of August 27, 2008, has been carefully studied. These claims define novel and unobvious subject matter under Sections 102 and 103 of 35 U.S.C., and therefore should be allowed. Applicant respectfully requests favorable reconsideration, entry of the present amendment, and formal allowance of the claims.

Election/Restrictions

It is noted that the restriction requirement has been made final.

Specification

The specification is objected to because claim 15 recites dissolving the substrate in an acid, but this is not in the disclosure. The specification has now been amended to recite that the substrate is dissolved with an acid. As claim 15 was part of the specification as filed, this is not new matter.

As claim 15 is an originally filed claim, this is not new matter.

Claim Objections

Claim 16 is objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim.

The present amendment cancels claim 16, so this objection is now moot.

Rejections under 35 U.S.C. 112

Claims 1-23, 25, 27, 32 and 33 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

This rejection is respectfully traversed. The term "substantially" has been deleted from the claims. Claim 23 has been amended to depend from claim 21, which specifically recites metal deposition.

Art Rejections

Claims 1-4, 7, 8, 16, 35, 32 and 33 are rejected under 35 U.S.C. 102(b) as being anticipated by Kovtyukhova et al., *Materials Science and Engineering C* **19**:255-262, 2002.

This rejection is respectfully traversed. Claim 1 recites as follows:

1. (Original) A method of preparing a material of a desired structure composed of nanoparticles, the method comprising

(iii) providing a substrate having pores or channels functionalized with an agent capable of binding nanoparticles, said pores or channels having a desired shape and a cross-

sectional size from about several nanometers to about several hundreds of microns; and

(iv) passing through said substrate a colloid solution comprising nanoparticles and a solvent, so as to bind and form more than one layer of nanoparticles in the pores or channels, where the nanoparticles spontaneously coalesce to form a coherent material;

thereby obtaining in said pores or channels a material composed of nanoparticles, said material having a substantially hollow structure that follows the shape of said pores or channels in the substrate.

It can clearly be seen that Kovtyukhova does not disclose each and ever element found in claim 1, nor in the claims dependent therefrom, for the following reasons:

1. In claim 1, the agent sued to functionalize (i.e., coat) the substrate is an agent capable of binding nanoparticles. Kovtyukhova recites at page 258, section 2.2, "a PC membrane was soaked in … PEI for 2.5 hr." There is nothing in Kovtyukhova the states that PEI is an agent capable of binding nanoparticles (such as TiO_2/ZnO).

2. Claim 1 recites that the colloidal solution, comprising nanoparticles and a solvent, is pass through the substrate. Kovtyukhova is silent with respect to this step. Kovtyukhova states that the membrane was (successively) immersed in aqueous TiO_2/ZnO. One skilled in the art can readily

appreciate that a step of passing a solution through a membrane is inherently different from immersing said membrane in a solution.

3. Claim 1 also recites, "the nanoparticles spontaneously coalesce to form a coherent material." Kovtyukhova does not disclose this. To make a point, Kovtyukhova teaches a washing step that follows the immersing step (page 258, section 2.2), and specifically recites, "adsorption and washing times were increased to 15-30 min." at page 258, first column, lines 8-9. Therefore, one skilled in the art would conceive that the washing step is required to be performed subsequent to the immersing procedure, and would appreciate that washing is required to complete the nanoparticle deposition, i.e., tubular growth. Further, Kovtyukhova recites a step of electrodeposition at page 259, first column, lines 2-3 and Figure 2, which provides an indication that the TiO_2/ZnO tubule growth is not spontaneous.

4. Additionally, claim 1 recites, "...thereby obtaining in said pores or channels a material composed of nanoparticles, said material having a substantially hollow structure that follows the shape of said pores or channels in the substrate." Kovtyukhova does not teach that the TiO_2/ZnO colloids conform to the shape of the pores. Thus, whereas one round of passing the nanoparticles colloid solution of claim 1 is sufficient to obtain a structure that follows the shape of

the pores (i.e., produces a uniform layer of nanoparticles that covers the substrate pore structure), Kovtyukhova recites at page 259, second column, lines 1-5, "in the alumina membrane [substrate], the metal ions [colloid solution] used in the second electrodeposition step fill voids between nanoparticle film and pore walls..." That is, in Kovtyukhova, the first cycle of immersion results in a void containing layer of nanoparticles, which to one skilled in the art, does not represent a structure that follows the shape of the pores.

5. Claim 1 recites that the material has a hollow structure. There is nothing in Kovtyukhova disclosing this feature of a hollow material.

From the above, it is clear that Kovtyukhova does not meet the limitations of claim 1. Claims 2-4, 7, 8, 16 and 32, which depend from claim 1, should also be considered novel over Kovtyukhova.

Claims 1-4, 7, 8, 16, 25, 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kovtyukhova.

This rejection is respectfully traversed. For the reasons given above, one skilled in the art, reading Kovtyukhova, would not arrive at the method or material claimed herein. In fact, in the abstract, Kovtyukhova states that the method is a layer-by-layer approach, whereas the herein claimed method is a one-step method of producing more than one layer of nanoparticles in the pores of channels where the nanoparticles

spontaneously coalesce to form coherent metallic-based material. Claim 25 specifically recites that the material has a hollow structure, which feature is neither disclosed nor suggested by Kovtyukhova.

Claims 5, 6, 9-11, 17, 20, 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over in view of Liu, *Chemical Physics Letters*, 1998, **298**:315-319 in view of Braunstein et al., *Chem. Eur. J.*, 2000, **6(24)**: 4537-4545.

This rejection is respectfully traversed. The process of Kovtyukhova and Liu is an electrostatic layer-by-layer deposition of multilayers in the membrane pores. This is fundamentally different from the process claimed herein, in which only one solution is passed through the pores and tubes are formed spontaneously by coalescence. That is, in the presently claimed process, one passage through the pores is sufficient to form the materials. In contrast thereto, in Kovtyukhova and in Liu, no tubes are formed if a single solution is used and if the solution is passed just once.

In Kovtyukhova and Liu, one of the two solutions that are used contains nanoparticles, while the other solution contains a charged polymer, and inherent feature in their processes. Hence, a polymer layer is always deposited in nanoparticle layers. Therefore, the "tubes" formed in these articles must contain a polymer as a major component. This is in clear contrast to the tubes prepared according to the

presently claimed process, which are metallic and exhibit metallic conductivity.

Braunstein adds nothing to Kovtyukhova and Liu, as Braunstein merely modifies membrane pores with molecules that bind gold nanoparticles and pass a gold colloid through the pores. However, under the conditions used by Braunstein, the product produced is fundamentally different from the product produced by the herein claimed process. Braunstein obtains sporadic binding of isolated gold nanoparticles on the pore walls, as can clearly be seen in Figure 1 and Scheme 3, and described in the text at page 4640, left column, "The latter showed the hoped-for presence of immobilized monodisperse particles without any aggregation." There is no disclosure in Braunstein of producing tubes or any type of self-sustaining structure, only sporadically bound isolated nanoparticles that disperse when the template is dissolved. This has nothing to do with the presently claimed method, wherein the gold nanoparticles aggregate and form a multilayer on the pore walls followed by coalescence, so that the product in the pores is in the form of solid metallic tubes. In the present claims, when the membrane template is dissolved, **self-sustained** metallic nanotubes are obtained. Braunstein provides no incentive to

combine the process disclosed therein with Kovtyukhova and Liu, because the product obtained by the Braunstein process is entirely different from the self-sustained tubes formed herein.

Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kovtyukhova in view of Liu and Braunstein and further in view of Mougin et al., *Colloids and Surfaces, A Physiochem. Eng. Aspects* **193**:231-237, 2001.

This rejection is respectfully traversed. Although Mougin teaches stabilizing gold nanoparticles with sodium citrate dehydrate, there is nothing in the combination of Kovtyukhova, Liu and Braunstein that would lead one skilled in the art to the process claimed herein. Therefore, using sodium citrate dehydrate to stabilize gold nanoparticles adds nothing to Kovtyukhova, Liu and Braunstein.

Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kovtyukhova in view of Liu and Braunstein and further in view of Mardilovich et al., *Journal of Membrane Science,* **98(1-2):**143-155, 1995.

This rejection is respectfully traversed. Mardilovich discloses that anodic alumina membranes can be dissolved by acid or by base. However, Mardilovich does not supply the deficiencies in the other cited references, as

discussed above. There is nothing in Mardilovich that discloses or suggests the single step process as claimed herein for preparing hollow materials.

Claims 18, 19 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over v in view of Liu and Braunstein and further in view of Martin et al., *J. Phys. Chem. B* **105**:1925-1934, 2001.

This rejection is respectfully traversed. Martin merely discloses depositing gold as the conductive layer forming an inside conductive layer. However, Martin is completely silent about the other features of the herein claimed process, which features are neither taught nor suggested by a combination of Kovtyukhova, Liu and Braunstein.

In view of the above, it is respectfully submitted that the claims are now in condition for allowance, and favorable action thereon is earnestly solicited.

Respectfully submitted,

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